

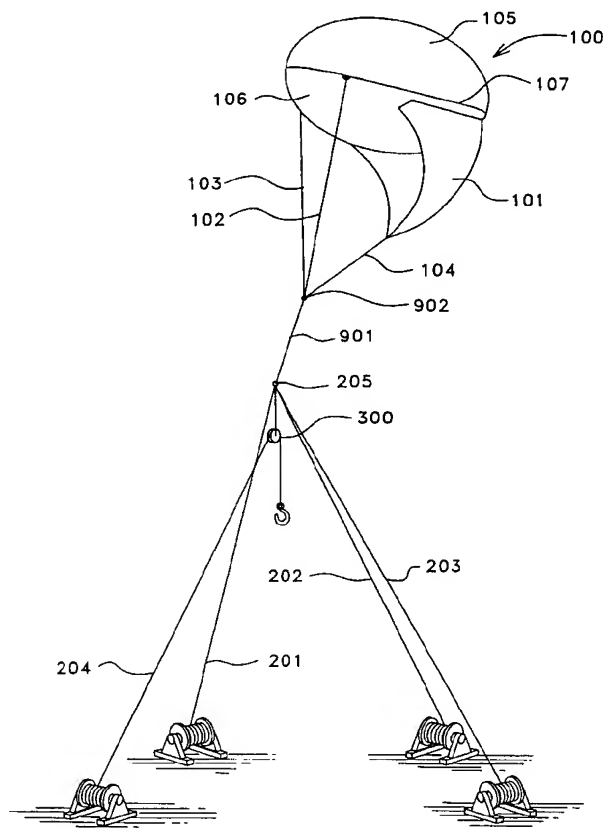


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(54) Title: BALLOON LIFTING SYSTEM**(57) Abstract**

The invention comprises a balloon system for lifting loads. A balloon (100) is attached to the apex (205) of a series of guy wires (201, 202, 203). The guy wires are attached to moveable or stationary anchor points, such as the ground or heavy vehicles. A pulley (300) is suspended from the peak or apex of the guy wires. A winch line (204) is routed from a lift winch on the ground over the pulley to a hook. The load is attached to the hook for lifting. The balloon comprises an airdam (101). The airdam provides lift and control in windy conditions. The position of the balloon can be controlled by moving the locations of the guy lines (201, 202, 203) independently or in unison, or by changing the length of each or all of the guy lines independently or in unison. The system also provides a platform for lifting various loads to a position above the ground.



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1

TITLE

2

Balloon Lifting System

3

CROSS-REFERENCE TO RELATED APPLICATION

4

5 This application is a non-provisional application
6 claiming the benefits of provisional application no.
60/132,621 filed May 5, 1999.

7

FIELD OF INVENTION

8

9 The present invention relates to the field of
10 lighter than air devices designed to lift loads with a
balloon and winch system.

11

12

BACKGROUND OF THE INVENTION

13

14 Balloon lift systems are known in the art. They
15 have enjoyed use in various industries, including search
16 and rescue and timber or logging. The systems generally
17 comprise a lighter than air lifting device, i.e.,
18 balloon, connected to a tether system that allows control
19 of the altitude and spatial location of the balloon. The
20 system allows a user to lift a load vertically. If
21 lateral movement of the load is required, a cross cable
22 system is used that allows the operator to laterally move
23 the lift cable. This moves the load and balloon. The
24 system requires the lateral movement cables to be placed
25 over the load and over the location where the load is to
26 be placed. They offer limited flexibility as far as
27 changing the location of placement of the load once the
28 load has been lifted. The lateral cable system is
29 generally cumbersome, and moving it is dangerous and
30 labor intensive. Further, balloon lift systems are
unstable in windy conditions, making them

1 unattractive for lifting work where winds are
2 encountered. By extension, wind sensitive systems cannot
3 offer added lift once a wind starts blowing.

4 Another area where balloon lift systems have been
5 used is for equipment platforms for aerial photography,
6 radar, light sources, weather monitoring stations and
7 similar uses. There is a need for simple to operate,
8 stable lift platform for many of these devices. Prior
9 art balloon lift systems have often been unsuited to
10 these uses because of the instability in windy conditions
11 noted above.

12 The present invention solves these problems by
13 creating a balloon which is stable in winds up to 90 MPH
14 or more. The present invention attaches an airdam
15 stabilizer to the balloon, allowing it to be used in many
16 conditions and for many uses that prior art balloon
17 systems were not suited for.

18

19 **SUMMARY OF THE INVENTION**

20 The main aspect of the present invention is to
21 provide a balloon lifting system having a balloon
22 tethered to an anchor point.

23 Another aspect of the present invention is to
24 provide a balloon lifting system having a winch for
25 lifting a load.

26 Another aspect of the present invention is to
27 provide a balloon lifting system having a plurality of
28 moveable guy lines.

29 Another aspect of the present invention is to
30 provide a balloon lifting system having a balloon
31 with an airdam for providing lift and

1 stability.

2 Another aspect of the present invention is to
3 provide a balloon lifting system that is stable in
4 extremely windy conditions.

5 Another aspect of the present invention is to
6 provide a balloon lifting system whereby lift increases
7 with increased wind speeds.

8 Another aspect of the present invention is to
9 provide a balloon lifting system whereby the balloon will
10 lift a load in windy conditions when filled with lighter-
11 than-air gas.

12 Another aspect of the present invention is to
13 provide a balloon lifting system whereby a load is lifted
14 to a position above the ground and held there.

15 Another aspect of the present invention is to
16 provide a balloon lifting system whereby a lifting
17 platform for various uses is provided.

18 Other aspects of this present invention will appear
19 from the following description and appended claims,
20 reference being made to the accompanying drawings forming
21 a part of this specification wherein like reference
22 characters designate corresponding parts in the several
23 views.

24 The invention comprises a system for lifting loads.
25 A balloon is attached to a series of guy wires. The guy
26 wires are attached to moveable or immovable anchor
27 points, such as the ground or heavy vehicles. A pulley
28 is suspended from the peak or apex of the guy wires. The
29 apex is located below the balloon. A winch line is
30 routed from a lift winch on the ground over the pulley to
31 a hook or any other means of attaching a load to the
32 lift line, known in the art. The load is attached

1 to the hook for lifting. The balloon further comprises
2 an airdam. The airdam provides lift in windy conditions,
3 up to 90 MPH. Moving the locations of the guy line
4 anchors independently or in unison can control the
5 position of the balloon. The guy line anchors are moved
6 to position the apex over a load. Once the load is
7 lifted, the guy line anchors can be moved to relocate the
8 apex. Once the apex is moved, the load can be lowered.

9 The present invention can also be used as an aerial
10 equipment platform for a wide variety of uses which
11 require an easy to use, stable platform.

12

13 **BRIEF DESCRIPTION OF THE DRAWINGS**

14 FIG. 1 is a bottom perspective view of the present
15 invention.

16 FIG. 2 is a bottom plan view of the balloon of FIG. 1.

17 FIG. 3 is a bottom perspective view of the balloon of
18 FIG. 1.

19 FIG. 4 is a table showing test results for the balloon.

20 FIG. 5 is a schematic of the invention showing the angle
21 of attack.

22 FIG. 6 is a bottom perspective view of the invention
23 lifting a load.

24 FIG. 7 is a top plan view of an alternative embodiment of
25 the rigging system.

26 FIG. 8 is a perspective view of the airdam before it is
27 attached to the balloon.

28 FIG. 9 is a bottom perspective view of an

1 alternate embodiment of the guy line attachment

2 FIG. 10 is a bottom perspective view of the present
3 invention used as an aerial equipment platform.

4 FIG. 11 is a bottom perspective view of the present
5 invention in still air showing the nose down
6 configuration of the balloon.

7 Before explaining the disclosed embodiment of the
8 present invention in detail, it is to be understood that
9 the invention is not limited in its application to the
10 details of the particular arrangement shown, since the
11 invention is capable of other embodiments. Also, the
12 terminology used herein is for the purpose of description
13 and not of limitation.

14

15 DETAILED DESCRIPTION OF THE DRAWINGS

16 FIG. 1 depicts a top perspective view of the present
17 invention. Balloon 100 is anchored to the ground or
18 other surface by guy lines 201, 202 and 203. Balloon 100
19 is known in the art and comprises any material available
20 that provides tear resistance when subjected to loads,
21 such as when the balloon is lifting a load. Although the
22 preferred embodiment has shown with three guy lines, any
23 number greater than two will also work as well.

24 Balloon 100 comprises an upper portion 105 and a
25 lower portion 106. The balloon 100 can be made a variety
26 of shapes, such as an oblong shape similar to a parasail.
27 A circular shape is the preferred embodiment because it
28 requires the least amount of gas to fill. Shrouds 102
29 and 103 are attached to apex 205 and to tether points on
30 a midline 107 on balloon 100. Airdam 101 is attached to
31 the lower portion 106 and to shroud 104 at tether

1 point 309. Airdam 101 provides lift and it allows the
2 balloon 100 to be steered into a prevailing wind. The
3 airdam 101 provides lift for the system when the wind is
4 blowing. Airdam 101 has a curvilinear shape that
5 enhances the aerodynamic behavior of the airdam and its
6 usefulness in providing lift as well as control of the
7 balloon.

8 The lifting capacity and the stability of the system
9 is enhanced by use of the airdam 101 on balloon 100. A
10 wind incident on the airdam 101 and balloon 100 will
11 cause the airdam 101 to generate lift, thereby increasing
12 the system's ability to lift a load. The system may be
13 used in winds over 90 mph. The airdam 101 is fabricated
14 of porous material, such as sheer organza nylon by
15 Rosebar Textile of, California. If a non-porous material
16 is used to make the airdam 101 the stability of the
17 system is greatly decreased.

18 FIG. 8 shows the airdam 101 before it is attached to
19 the balloon 100. Airdam 101 has a height d_1 and a width
20 at the longest point of d_3 . The length of d_3 is
21 preferably less than $\frac{1}{2}$ the circumference of the balloon
22 100. The airdam 101 is attached to balloon 100 on the
23 lower portion 106 along attachment edges 801, 802 and
24 803. The edges 802 and 803 are at an acute angle χ
25 measured from line A. In the preferred embodiment angle
26 χ is 40° .

27 The airdam 101 can be attached to the balloon 100
28 with adhesives or by sewing. The airdam 101 must be
29 attached below the midline 107 on the lower portion 106.
30 If the airdam 101 is attached at the midline 107 the
31 balloon is unstable and tends to oscillate in the wind.

32 FIG. 2 is a bottom plan view of the balloon.
33 Airdam 101 is attached to the lower portion 106.

1 Shroud 102 is attached to balloon 100 at tether point
2 115. Shroud 103 is attached to balloon 100 at tether
3 point 116. Tether points 115 and 116 are located at
4 points at an angle of approximately 45° to a centerline C.
5 Tether points 115 and 116 further comprise any known
6 grommet arrangement used to strengthen a line connection
7 point.

8 One example of the balloon 100 was made using a 20ft
9 diameter round balloon from Giant Advertising, Inc. of
10 Huntington Beach, Calif. The balloon 100 was made from
11 polyurethane coated nylon. The airdam 101 was made from
12 nylon organza. D_1 equaled 7ft; and d_2 equaled 27 ft on
13 the airdam 101. Sides 802 and 803 were 2 ft each. The
14 airdam was attached about 2 ft down from the midline 107
15 with transfer tape, Killer Red™ made by Bron Tape Co. of
16 Denver, CO.

17 As shown in FIG. 1, guy lines 201, 202, and 203 are
18 each attached to a mounting or anchor point, such as the
19 ground or a heavy vehicle 401, 402, 403. Pulley 300 is
20 attached to the apex 205. Apex 205 is a common
21 connection point of guy lines 201, 202, and 203 and is
22 located below the balloon. Winch line 204 is connected
23 to a load L and used to lift a load L. Winch line 204 is
24 routed from the lift winch 301, over pulley 300 to a load
25 L. Balloon 100 is attached to apex 205 with the shrouds
26 102, 103 and 104 as described above.

27 In an alternate embodiment, shown in FIG. 9 a
28 secondary tether 901 separates the connection point of
29 the guy wires 201, 202 and 203, the apex 205, from a
30 common connection point 902 of the shrouds 102, 103 and
31 104. That is, a single tether 901 is used to extend the
32 balloon above the apex 205 by a predetermined number of
33 feet. In effect, the shrouds 102, 103 and 104

1 are connected to a common point 902. The common point
2 902 is then connected by a length of tether 903, to the
3 apex 205 below the common connection point 902 for the
4 shrouds. This arrangement can enhance the stability of
5 the system in high winds by elevating the balloon 100
6 further above the apex 205.

7 In operation, balloon 100 is inflated with helium,
8 or any other 'lighter-than-air' gas. The diameter of the
9 balloon may range from 10 feet to 100 feet or more,
10 depending upon the necessary lifting requirements. Guy
11 lines 201, 202 and 203 are then deployed in such a manner
12 so as to allow balloon 100 to rise to a predetermined
13 elevation, over a particular location. The elevation may
14 range up to several thousand feet above the ground, only
15 limited by the length of the guy lines 201, 202 and 203.
16 The location of the balloon 100 is controlled by the
17 location of the anchor 401, 402 and 403 of each guy line,
18 and thereby each guy line 201, 202 and 203. Movement of
19 a particular guy line anchor 401, 402, or 403 will result
20 in a corresponding movement of the balloon 100 and apex
21 205.

22 In an alternate embodiment shown in FIG. 5, the guy
23 lines 201, 202, and 203 are attached to immovable anchors
24 501; and then the lengths of the guy lines 201, 202 and
25 203 may be adjusted to properly position the location of
26 the balloon 100 and apex 205. Selectively lengthening or
27 shortening each or all of the guy lines 201, 202, and 203
28 will move the location of the apex 204 and the balloon
29 100, due to the triangular arrangement of the guy lines.
30 For example, this is accomplished by attaching each guy
31 line 201, 202 and 203 to a winch 502. The length of each
32 guy line 201, 202 and 203 is then adjusted by reeling or
33 unreeling the given guy line on its winch 502. Each
34 winch 502 described herein is controlled by an

1 operator or by a series of operators working in unison.
2 This system will work as well with any number of guy
3 lines, ranging from two on up.

4 To lift a load off a rooftop, as shown in FIG. 1,
5 once deployed, guy line anchor 401 is moved in order to
6 cause the apex 205 to move over the roof. The geometry
7 of the situation will dictate the length and direction of
8 movement of the guy line anchor 401, or a plurality of
9 guy line anchors 401, 402 and 403. Lift winch 301 is
10 then operated to lower the hook 305 to the roof. Once
11 the load L is attached, winch line 204 is reeled in,
12 thereby raising load L. Guy line anchor 401 is then
13 moved back in the direction it came from in order to move
14 the apex 205 from over the roof. Once load L is over the
15 area where it is to be placed, winch line 204 is unreeled
16 and the load L is lowered. Each of these movements is
17 made in consideration of and with respect to the
18 prevailing winds.

19 If very heavy loads are to be lifted with the
20 balloon 100 it can be necessary to use an alternate
21 attachment or rigging system 700, as shown in FIG. 7,
22 because a heavy load could cause the balloon fabric to
23 tear. A center ring 701 has three rigging lines 702, 703
24 or 704 attached to it. The center ring 701 is attached
25 to the balloon 100 at top midpoint C, either by sewing or
26 adhesives. The lines 702, 703 and 704 correspond to
27 shrouds 102, 103 and 104 and are spaced identically on
28 the balloon 100. Extra stress lines 705 can be added
29 between line 702, 703 and 704 to further distribute the
30 weight over the top surface 105 of the balloon 100. Line
31 704 is further attached to the attachment point 306 on
32 the airdam 101 to hold the airdam 101 taut. The lines
33 702, 703 and 704 can be run through rings 706 attached to
34 the balloon 100 to further hold the lines 702, 703 and

1 704 in position.

2 The system is also used to provide a platform for
 3 lifting a load from the ground to a position above the
 4 ground as shown in FIG. 10. The balloon 100 is rigged
 5 with the shrouds 102, 103 and 104 as described above.
 6 The apex 205 is then attached to a single tether or winch
 7 line 1001. Load lines 1003, 1004 and 1005 are attached
 8 to the lower portion 106 at connection points 1006. A
 9 video camera 1002 is attached to the load lines 1003,
 10 1004 and 1005. The video camera 1002 is then raised to a
 11 position above the ground where it can be used to survey
 12 the surrounding area. Other loads may include radar,
 13 radar reflectors, signal transmitters, light sources,
 14 advertising banners, artillery targets, fire hoses, water
 15 buckets, guns, observation baskets for personnel, or any
 16 other load suitable for lifting by the system. The
 17 invention will lift each load in high prevailing winds
 18 and remain stable so that the equipment can function.

19 The lifting capacity of the system is as follows,
 20 offered by way of example and not of limitation:

Balloon Diameter/Ft.	Balloon Volume/Ft. ³	Balloon Lift Force/lbs.
10	189.1	11.81
20	1513.1	94.56
30	5106.6	391.16
50	23,641.7	1477.60
75	79790.7	4986.9
100	189,133.6	11,820.85

21 The entire system can be moved to allow placement of
 22 the apex 205 in any desired location. This is
 23 accomplished by moving all guy line anchors 401, 402, 403
 24 in a coordinated manner, individually or in unison,

1 or by changing the length of each or all of the guy lines
2 independently, or in unison.

3 The balloon 100 will lift a load L in winds in
4 excess of 10 MPH even if it is filled with gas that is
5 not lighter-than-air, for example, an atmospheric mix of
6 gasses. The airdam 101 provides lift for the balloon 100
7 in windy conditions in the absence of any lift being
8 provided by the gas filling the balloon 100 itself.

9 The lifting characteristics of the invention are
10 described in terms of the angle of attack of the balloon.
11 FIG. 5 is a schematic of the invention showing the angle
12 of attack. The airdam 101 allows the balloon to lift
13 loads in a stable manner in winds up to 90 MPH. When the
14 wind blows from direction W toward the invention, the
15 tether 650 will assume a characteristic angle α . In the
16 preferred embodiment of the invention $\alpha = 58^\circ$.

17 The shrouds 102, 103 and 104 on the balloon 100 are
18 arranged such that the balloon 100 assumes a ``nose-down~~❏~~
19 attitude in still air, as shown in FIG. 11. The
20 magnitude of the nose-down condition, or attack angle A,
21 is measured in terms of angle β , which is measured from a
22 centerline of the balloon as compared to its relationship
23 to a line normal to the tether centerline, as shown in
24 FIG. 5. A negative β is generally required to achieve
25 the proper stable flight attitude. The range of A is
26 from 0° to -10° . The best mode of the invention is to
27 have $A = -4^\circ$. The attack angle A is calculated by the
28 equation:

$$29 \quad A = 90^\circ - (\alpha + \beta)$$

30 FIG. 3 is a bottom elevation view of the
31 balloon. Balloon 100 comprises airdam 101.

1 Airdam 101 is attached to the lower portion 106 of the
2 balloon. Shrouds 102, 103 are attached to the lower
3 portion 106, and shroud 104 attached to airdam 101. The
4 shrouds 102, 103 and 104 are in turn attached to apex
5 205. The apex is attached to a single tether line 303.
6 The single tether line 303 is used whenever the balloon
7 100 is used for lifting a load to a set height, such as
8 holding a camera aloft as shown in FIG. 10, and not
9 moving the load from one point to another, such as
10 lifting a load off a building as shown in FIG. 1.

11 When the airdam 101 is mounted on the balloon 100
12 and the balloon is flown the airdam 100 forms a left wall
13 LW generally parallel to a central axis CX of the balloon
14 100, wherein the left wall LW has an axis LX. The left
15 wall LW is curved facing outbound from central axis CX.
16 It joins a symmetrically shaped right wall RW which has
17 an axis RX. The right wall is also curved convex facing
18 outboard from the central axis CX. The left and right
19 walls join at the rear of the balloon forming a rear
20 joint RJ, thereby creating a pocket CP. The left and
21 right walls also depend symmetrically downward to form a
22 tail section T which has a triangular cross section,
23 ending with the attachment point 306. The fabric of the
24 airdam 101 often stretches in strong wind, increasing d_1
25 of the airdam 101.

26 When in a wind W, airdam 101 causes the front F of
27 the balloon to be directed into the prevailing wind.
28 Airdam 101 has a concave pocket CP to contain and control
29 an impinging airflow. Airdam 101 stabilizes the balloon
30 100 so that it will not oscillate from side to side in
31 varying wind conditions. In the event of a shift in wind
32 direction, the weather-vane behavior of the balloon 100
33 causes it to simply assume a stable, down-wind position.
34 The balloon 100 automatically adjusts

1 itself to a position down-wind of the prevailing wind
2 direction via the drag of the concave packet CP.

3 FIGS. 4a and 4b is a table showing test results for
4 the balloon. FIG. 4a depicts the drag force and FIG. 4b
5 lift force of the balloon for various wind speeds,
6 ranging from 10 mph to 90 mph. The table is for balloon
7 diameters of 10 feet to 100 feet.

8 Although described herein in terms of lifting a load
9 from a roof, the system can be used to lift any
10 appropriately sized load from any first elevation to any
11 second elevation, or, from any first location to any
12 second location at the same elevation.

13 Although the present invention has been described
14 with reference to preferred embodiments, numerous
15 modifications and variations can be made and still the
16 result will come within the scope of the invention. No
17 limitation with respect to the specific embodiments
18 disclosed herein is intended or should be inferred.

19

1 I CLAIM:

2 1. A balloon suitable for lifting a load, said
3 balloon comprising:

4 an upper and a lower portion and a central axis;
5 said lower portion having an airdam;
6 said airdam having a left and a right wall, each
7 depending down from the balloon, wherein said
8 left and right walls are symmetrical;
9 said left and right walls further comprising a
10 rear joint, thereby forming a forward facing
11 pocket;
12 said left and right walls further comprising a
13 tail section; and
14 a load attachment system.

15 2. The balloon of claim 1, wherein said load
16 attachment system further comprises:
17 one or more attachment points on said balloon;
18 one of more attachment lines attached to the
19 attachment points; and
20 a load attached to said attachment lines.

21 3. The balloon of claim 2, wherein the balloon has
22 a generally circular circumference.

23 4. The balloon of claim 2, wherein the balloon is
24 filled with gas.

25 5. The balloon of claim 4, wherein the balloon is
26 filled with lighter-than-air gas.

27 6. The balloon of claim 2 further comprising:

1 two or more rigging attachment points on said
2 balloon and a rigging attachment point on the
3 tail section of the airdam;
4 rigging lines attached to the rigging attachment
5 points, said rigging lines meeting at an apex
6 point a given distance bellow the balloon; and
7 at least one tether line attached to the apex.

8 7. The balloon of claim 6, wherein the tether line is
9 attached to a winch.

10 8. The balloon of claim 1, wherein said load
11 attachment system further comprises:

12 an attachment harness shaped to encompass the
13 upper portion of the balloon, the attachment
14 harness being attached to the top portion of
15 the balloon;
16 two rigging lines attached to the attachment
17 harness;
18 a third rigging line being attached to the
19 attachment harness and further being attached
20 to the tail of the airdam;
21 the rigging lines meeting at an apex a given
22 distance bellow the balloon.

23 9. A balloon lifting system comprising:

24 a balloon having an upper surface, a lower surface
25 and a midline;
26 an airdam having a generally triangular shape
27 attached to the lower surface along an

1 attachment edge;
2 said airdam further comprising an attachment point
3 opposite said attachment edge;
4 two rigging lines attached to said balloon along
5 said midline and a third rigging line attached
6 to said attachment point, said three rigging
7 lines further attaching to an apex;
8 a load attached to said apex; and
9 at least one tether line attached to said apex.

10 10. The balloon lifting system of claim 9, wherein
11 the balloon has a generally circular circumference.

12 11. The balloon lifting system of claim 9, wherein
13 the balloon is filled with gas.

14 12. The balloon lifting system of claim 9, wherein
15 the balloon is filled with lighter-than-air gas.

16 13. A balloon suitable for lifting a load, said
17 balloon comprising:

18 an upper and a lower portion and a central axis;
19 said lower portion having an airdam;
20 said airdam having a left and a right wall, each
21 depending down from the balloon, wherein said
22 left and right walls are symmetrical;
23 said left and right walls further comprising a
24 rear joint, thereby forming a forward facing
25 pocket;
26 said left and right walls forming a tail section;
27 and

1 said balloon having a diameter of at least eight
2 feet.

3 14. The balloon of claim 13, wherein said airdam
4 further comprises a concave facing forward curvature
5 along a rear surface that provides a lift.

6 15. The balloon of claim 14 further comprising a load
7 attachment system.

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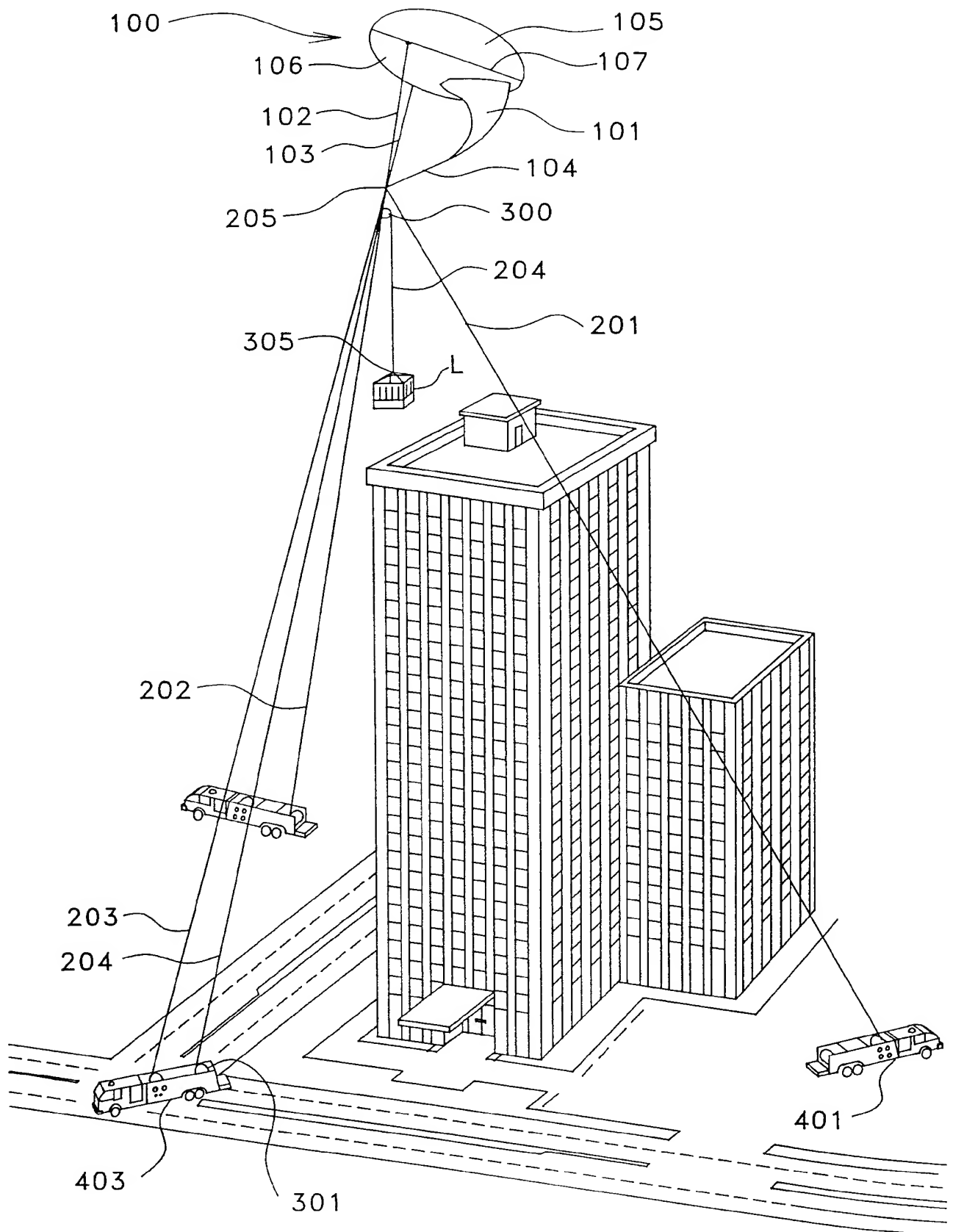


FIG. 1

SUBSTITUTE SHEET (RULE26)

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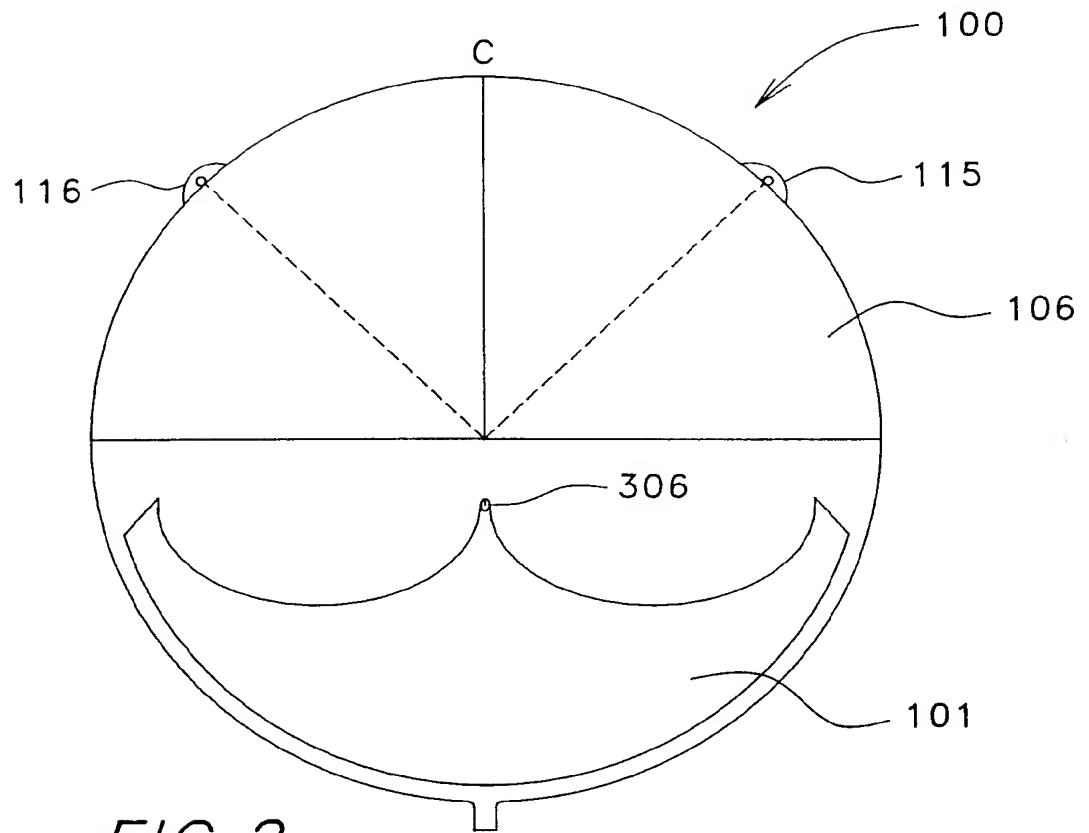


FIG. 2

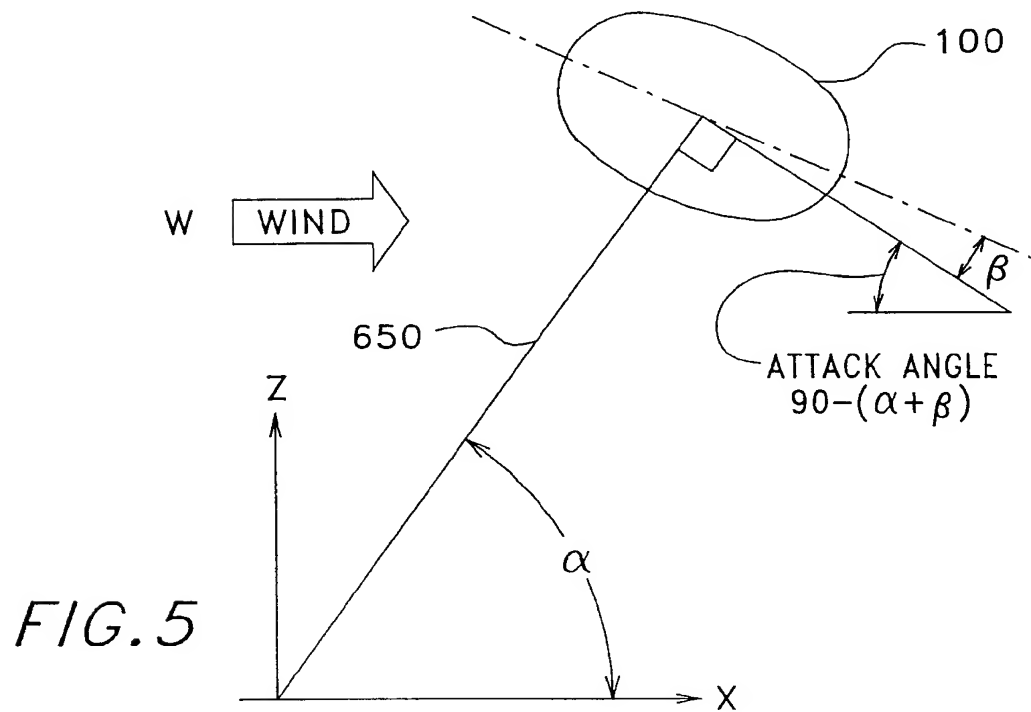
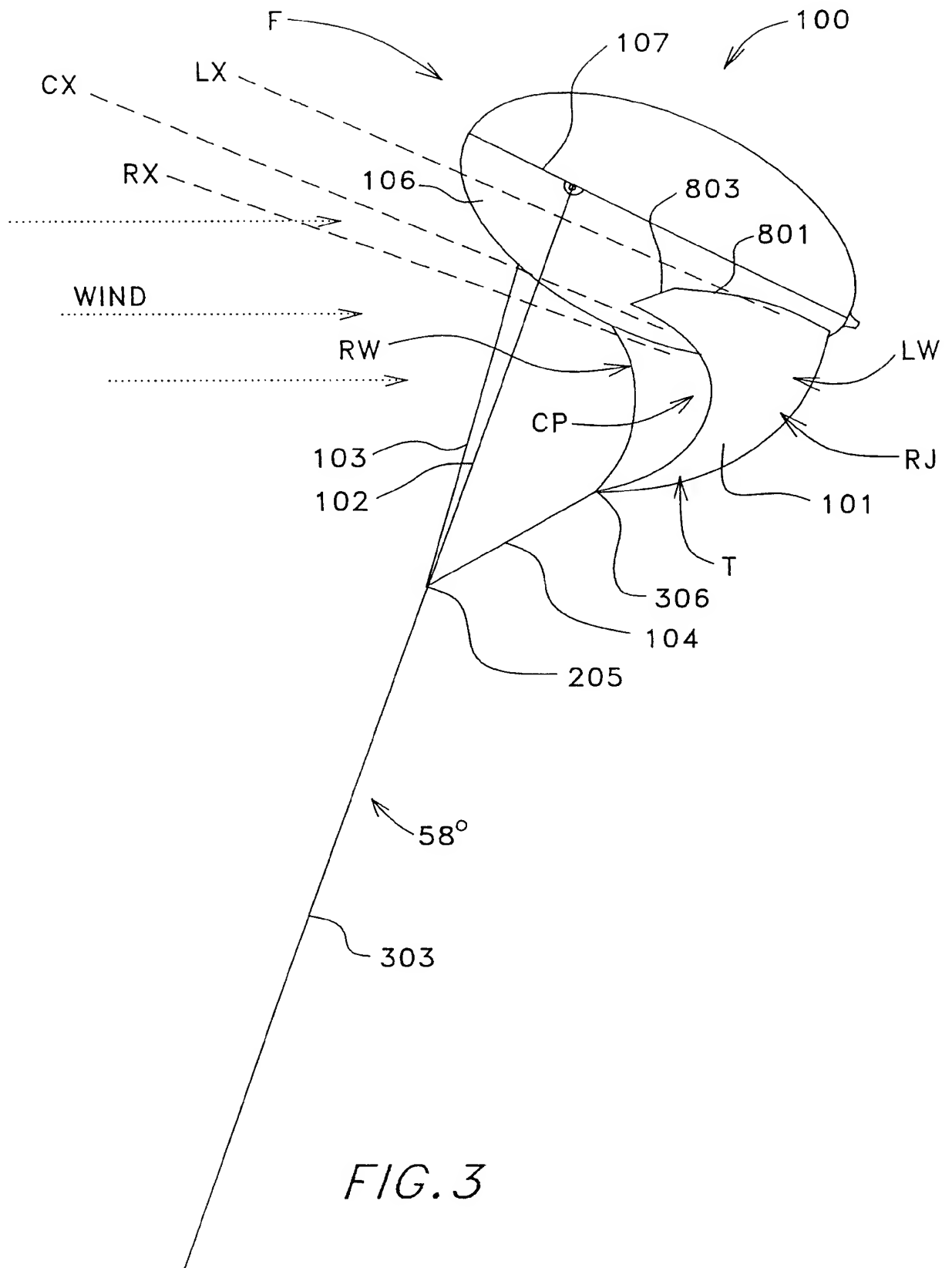


FIG. 5

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I. DRAG FORCE (LB.)

WIND SPEED	SIZE(DIAMETER OF THE BALLOON BEFORE INFLATION, FT.)					
	10	20	30	50	75	100
	ESTIMATED VOLUME CREATED AFTER INFLATION (CU. FT.)					
	189.1	1513.1	5106.6	23641.7	79790.7	189133.6
WIND SPEED	ESTIMATED CROSS SECTION AREA AFTER INFLATION (SQ. FT.)					
	49.7	199.0	447.7	1243.7	2798.4	4975.0
10	7.0	28.1	63.1	175.4	394.6	701.5
15	15.8	63.1	142.0	394.6	887.8	1578.3
20	28.0	112.2	252.5	701.4	1578.3	2805.9
25	43.8	175.4	394.5	1096.0	2466.1	4384.2
30	63.1	252.5	568.1	1578.3	3551.2	6313.3
35	85.8	343.7	773.3	2148.2	4833.5	8593.1
40	112.1	448.9	1010.0	2805.8	6313.2	11223.6
45	141.9	568.2	1278.3	3551.1	7990.1	14204.9
50	175.2	701.5	1578.1	4384.0	9864.4	17536.9
55	212.0	848.8	1909.6	5304.7	11935.9	21219.6
60	252.3	1010.1	2272.5	6313.0	14204.7	25253.1
65	296.1	1185.5	2667.1	7409.0	16670.8	29637.3
70	343.4	1374.9	3093.2	8592.7	19334.1	34372.3
75	394.2	1578.3	3550.8	9864.1	22194.8	39458.0
80	448.5	1795.8	4040.0	11223.1	25252.8	44894.4
85	506.3	2027.3	4560.8	12669.9	28508.0	50681.6
90	567.6	2272.8	5113.2	14204.3	31960.5	56819.5

FIG. 4a

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II. LIFT FORCE (LB.)

WIND SPEED	SIZE(DIAMETER OF THE BALLOON BEFORE INFLATION, FT.)					
	10	20	30	50	75	100
	ESTIMATED VOLUME CREATED AFTER INFLATION (CU. FT.)					
	189.1	1513.1	5106.6	23641.7	79790.7	189133.6
	ESTIMATED CROSS SECTION AREA AFTER INFLATION (SQ. FT.)					
	49.7	199.0	447.7	1243.7	2798.4	4975.0
10	6.1	24.5	55.1	153.0	344.2	611.9
15	13.8	55.1	123.9	344.2	774.5	1376.8
20	24.5	97.9	220.3	611.9	1376.8	2447.7
25	38.2	153.0	344.2	956.1	2151.3	3824.5
30	55.0	220.3	495.6	1376.8	3097.8	5507.3
35	74.9	299.8	674.6	1873.9	4216.5	7496.1
40	97.8	391.6	881.1	2447.6	5507.3	9790.8
45	123.8	495.7	1115.1	3097.7	6970.1	12391.5
50	152.8	611.9	1376.7	3824.4	8605.1	15298.1
55	184.9	740.4	1665.8	4627.5	10412.1	18510.7
60	220.1	881.2	1982.4	5507.1	12391.3	22029.3
65	258.3	1034.2	2326.6	6463.2	14542.6	25853.8
70	299.5	1199.4	2698.3	7495.8	16866.0	29984.3
75	343.9	1376.8	3097.5	8604.8	19361.4	34420.8
80	391.2	1566.5	3524.3	9790.4	22029.0	39163.2
85	441.7	1768.5	3978.6	11052.5	24868.7	44211.6
90	495.2	1982.6	4460.4	12391.0	27880.5	49565.9

FIG. 4b

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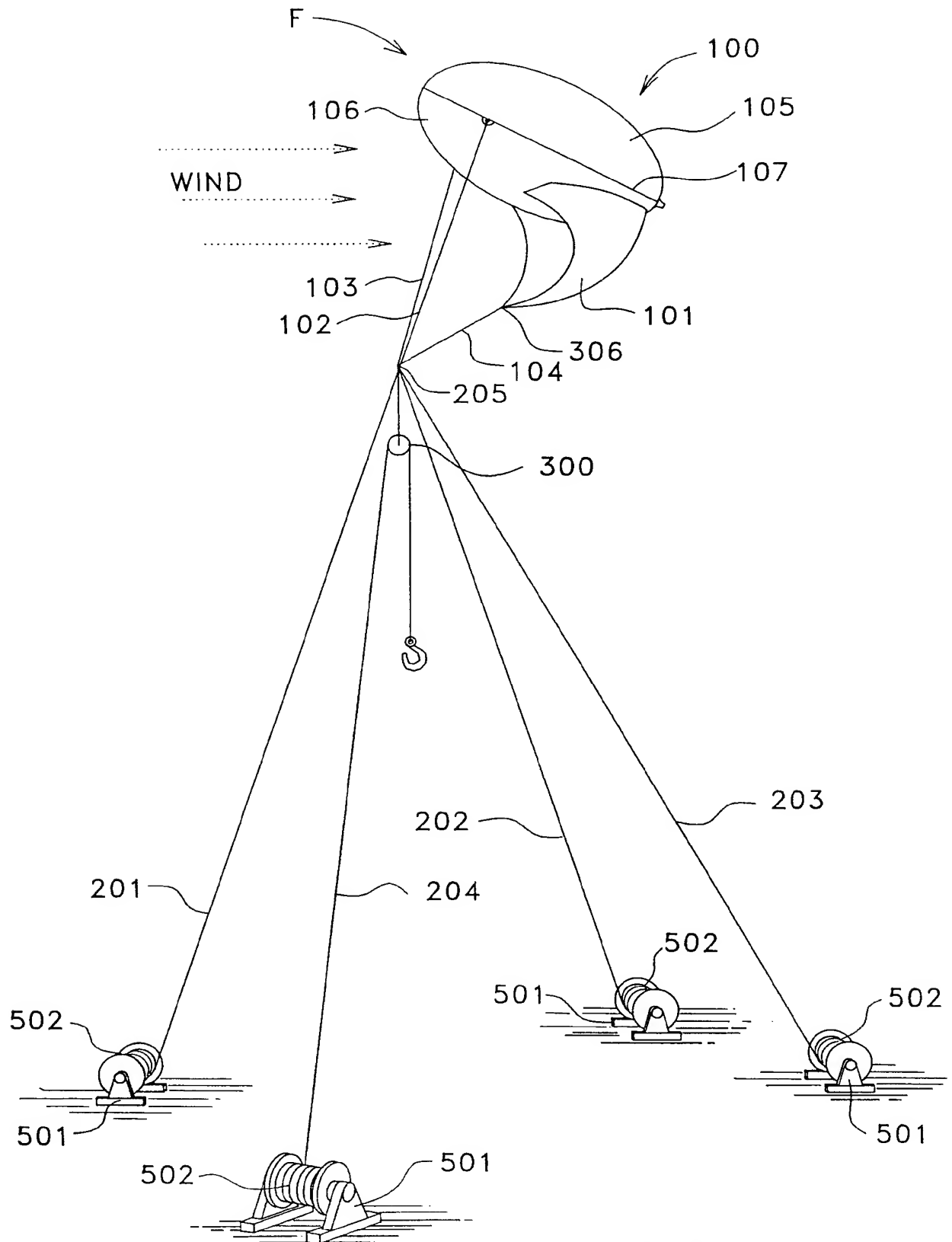


FIG. 6

SUBSTITUTE SHEET (RULE26)

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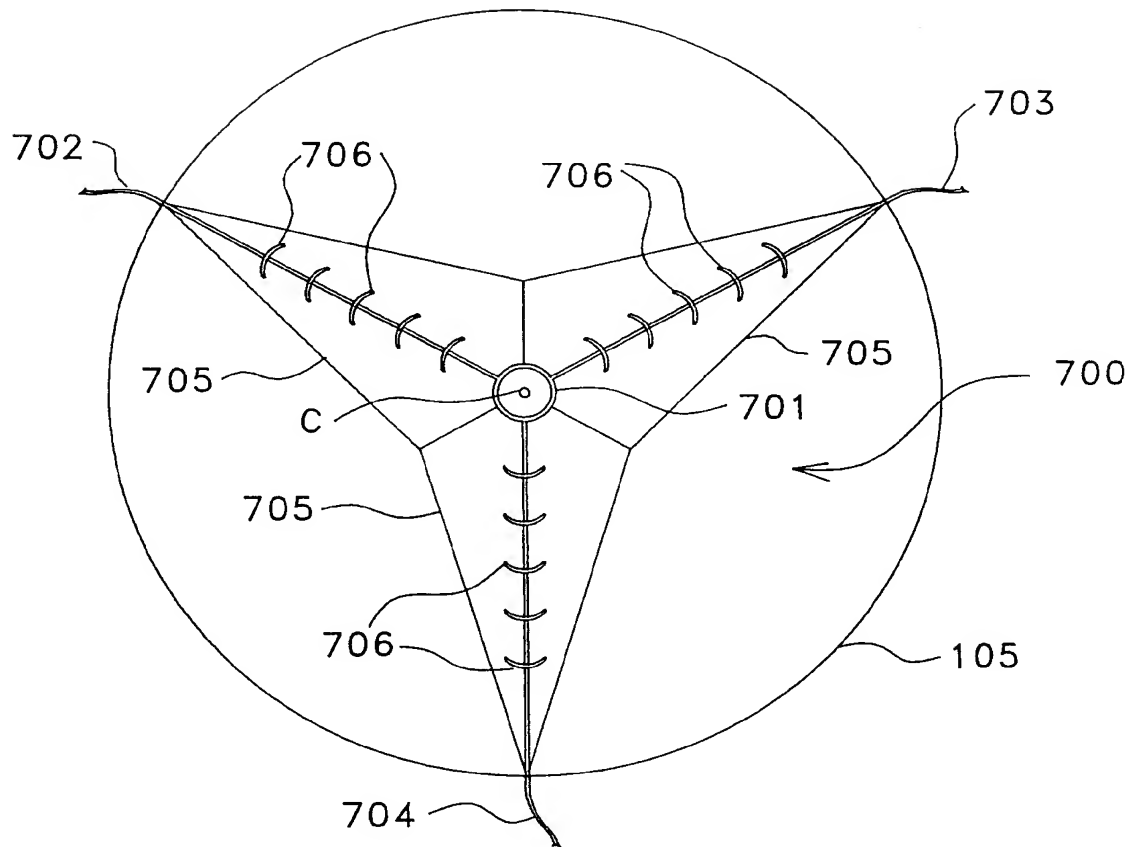


FIG. 7

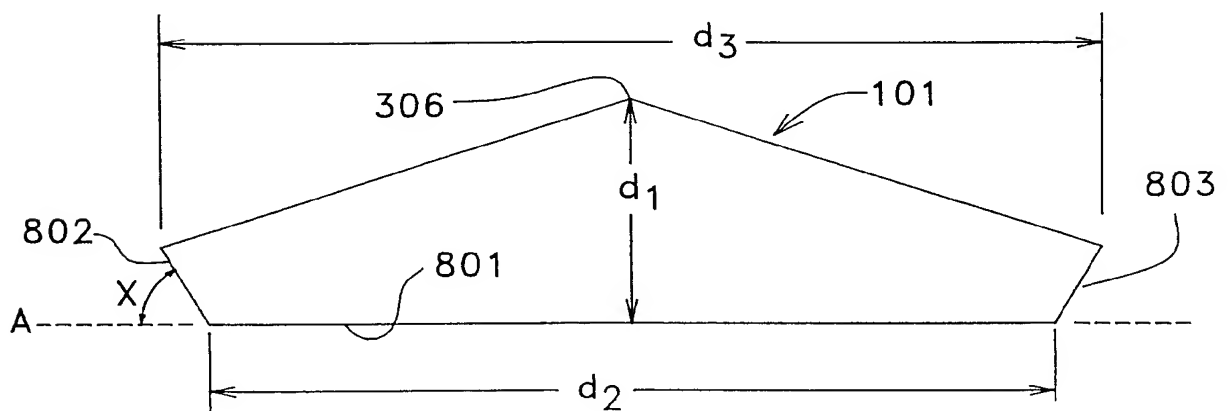


FIG. 8

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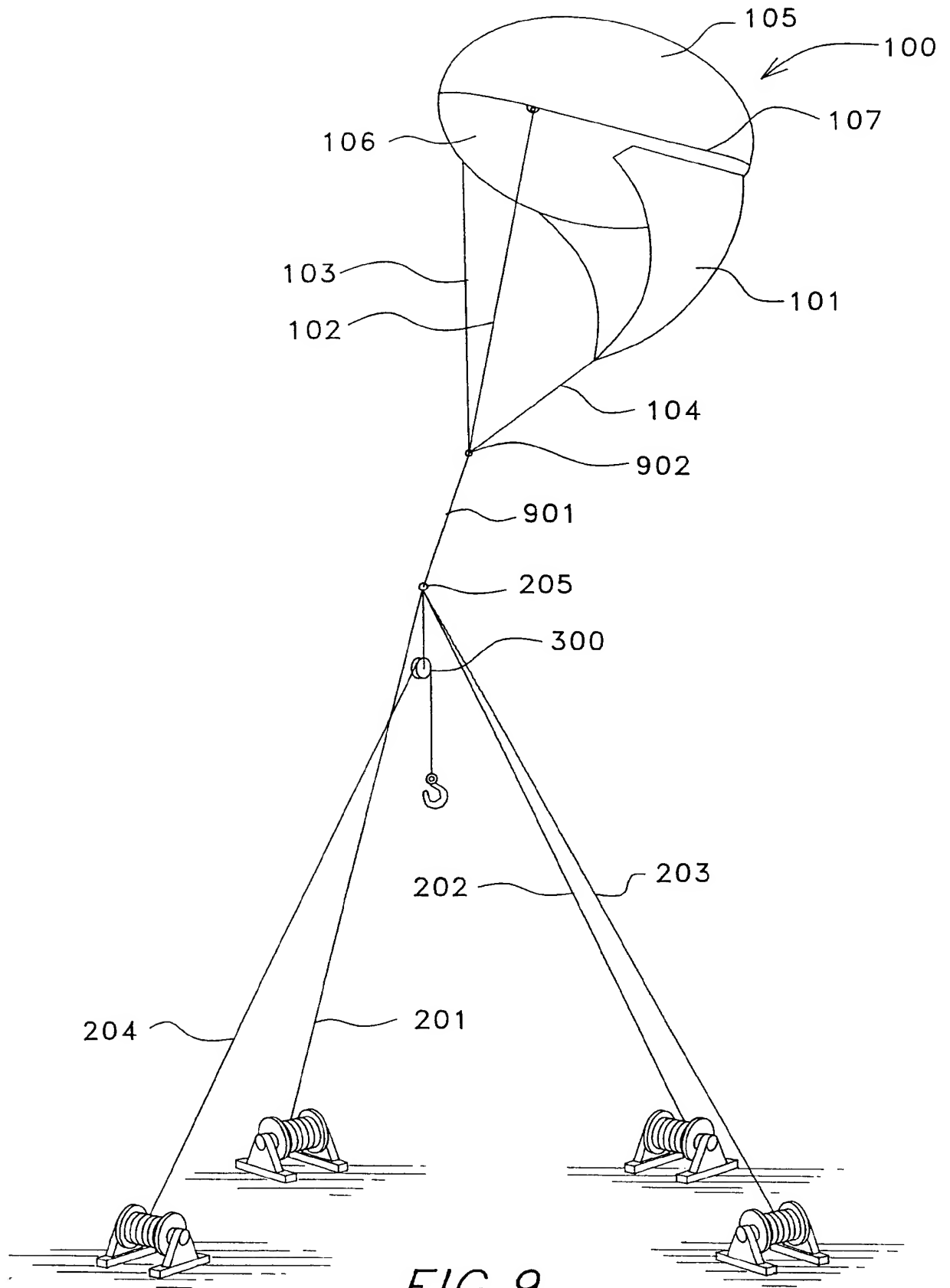


FIG. 9

SUBSTITUTE SHEET (RULE26)

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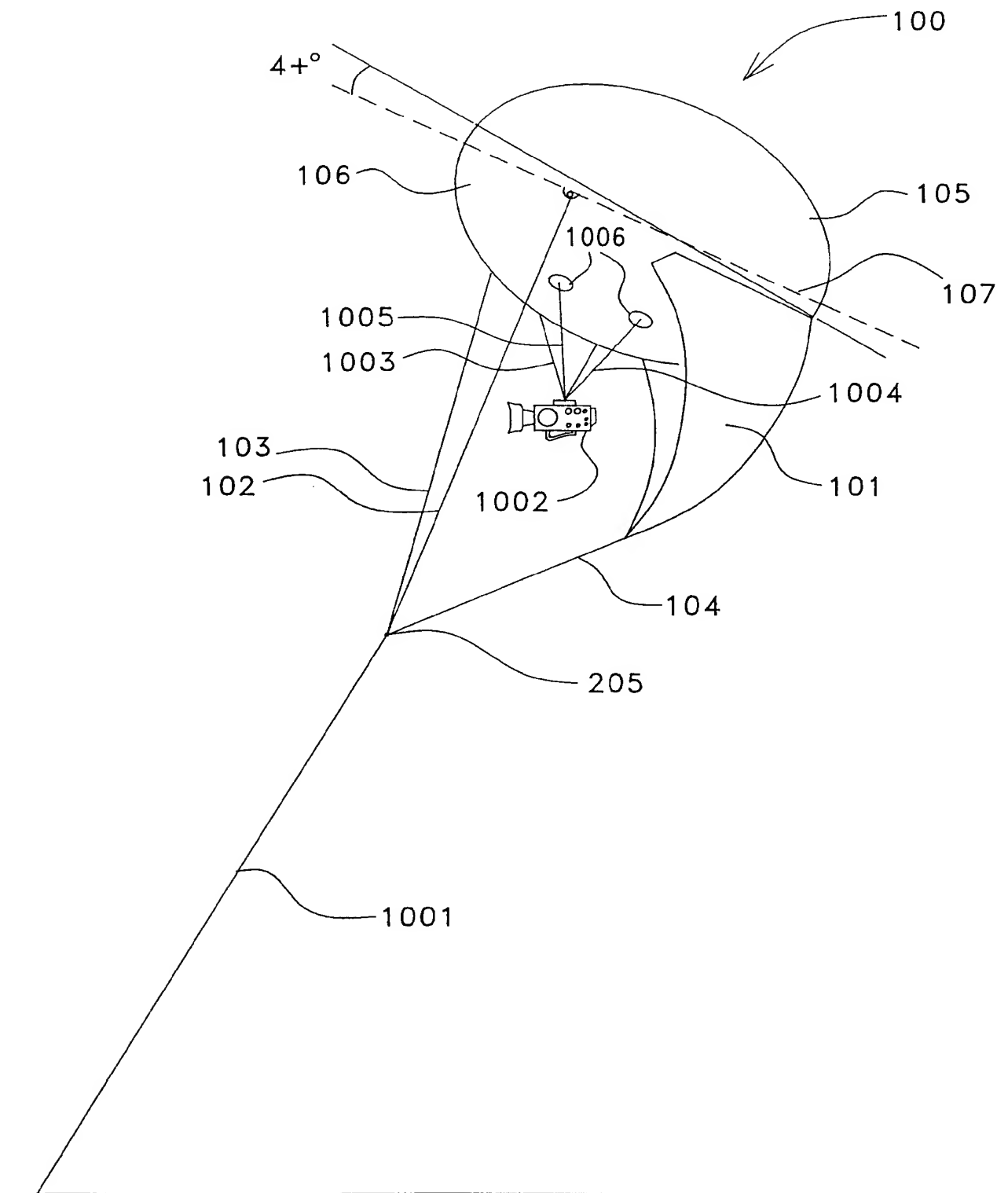


FIG. 10

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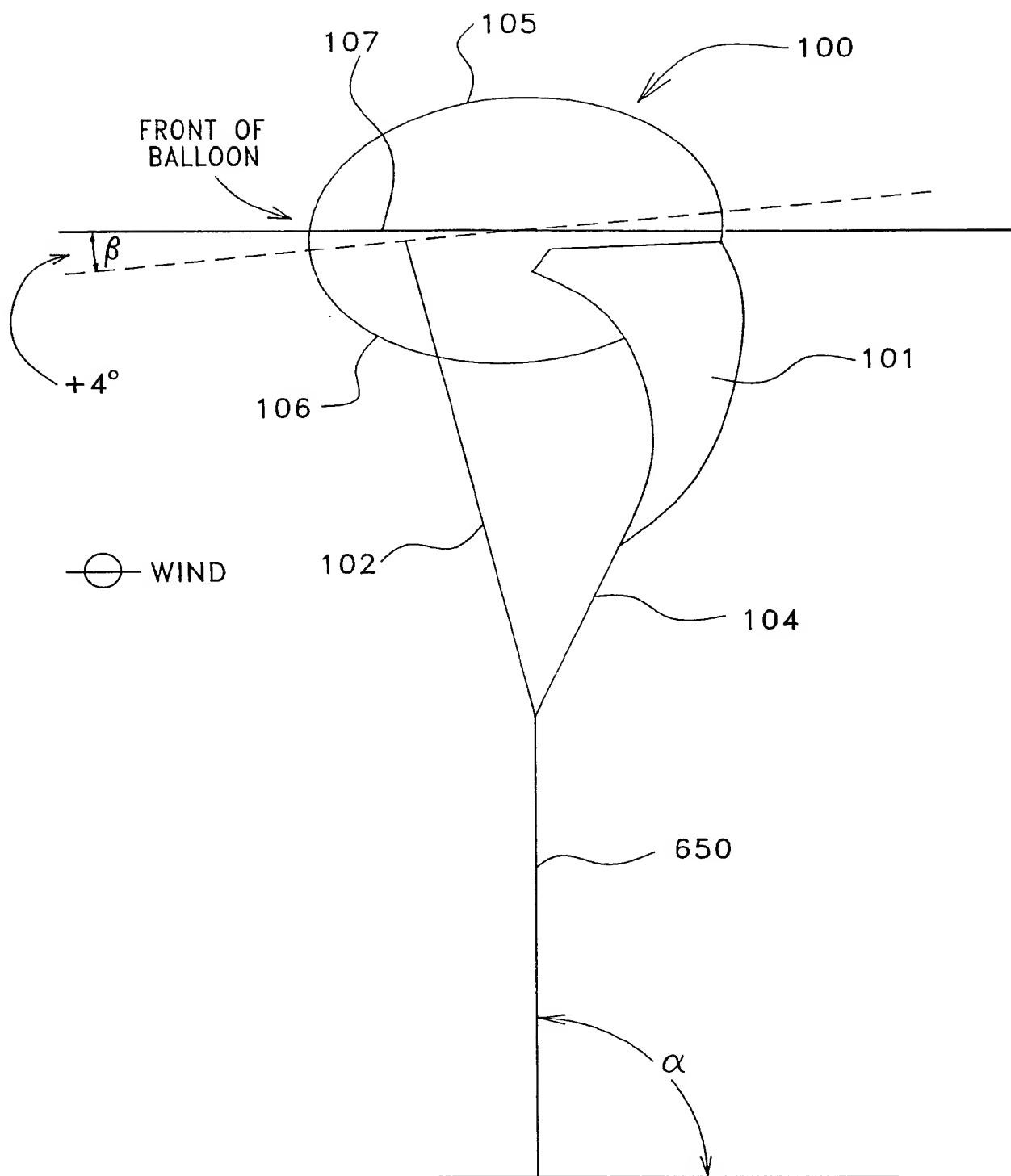


FIG. 11

SUBSTITUTE SHEET (RULE26)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/12305

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B64B1/42 B64B1/50 B64B1/52

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B64B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 1 686 646 A (UPSON R H) 9 October 1928 (1928-10-09)	1-5, 13
A	page 2, line 12 - line 42 page 3, line 5 - line 19	9-12
X	FR 787 642 A (ZODIAC) 26 September 1935 (1935-09-26) the whole document	1-5, 13
A	DE 75 731 C (RIEDINGER A, VON SIEGSFELD H) 5 October 1898 (1898-10-05) the whole document	1-5, 9-13
A	GB 147 161 A (THE GOODYEAR TIRE AND RUBBER CO.) 27 October 1921 (1921-10-27) page 2, line 48 - line 60	1, 2, 4, 5, 9, 11-13
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

16 August 2000

Date of mailing of the international search report

30/08/2000

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Fax: (+31-70) 340-3016

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Calvo de Nõ, R

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/12305

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 620 486 A (ROSS ROBERT S ET AL) 16 November 1971 (1971-11-16) the whole document	1-5, 9, 13-15
A	"Hoisted by skyhook" PRODUCT ENGINEERING, 12 October 1964 (1964-10-12), page 57 XP002145056 the whole document	1-5, 9, 13-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/12305

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 1686646	A	09-10-1928	NONE
FR 787642	A	26-09-1935	NONE
DE 75731	C		NONE
GB 147161	A		NONE
US 3620486	A	16-11-1971	NONE